viti-notes

[vineyard activity guides]

Research to Practice

A method for assessing soil structure

Viti-note Summary:

- Equipment
- Timing
- Method
- Interpreting results

Other topics in this Viti-Notes series include:

- Measuring the infiltration rate of water into soil using the ring infiltrometer method
- A method for examining grapevine root systems
- Soil moisture monitoring
- Measuring soil porosity
- Measuring soil strength
- *A method for assessing soil structure*
- Taking soil samples
- Measuring soil pH
- Measuring soil salinity
- Measuring organic carbon in soil

Soil structure is one of the major factors affecting winegrape production and profitability. Poor soil structure can limit root development, water infiltration and water availability for crop growth. Good soil structure allows water and air to move freely into the soil therefore avoiding waterlogging and run-off. Plant roots are able to explore a larger volume of soil and thus access more water and nutrients stored in the soil.

The deterioration of soil structure occurs by two processes:

- Slaking of aggregates;
- Dispersion of clay.

Slaking is defined as the rapid disintegration by pure water (e.g. rain water) of large aggregates (>2-5 mm) of soil into smaller aggregates (most of which are <0.25 mm). As slaked soil dries, the small aggregates settle together and create smaller soil pores than for the previous larger aggregates. Slaking occurs because of a lack of strong organic bonds between soil particles and micro-aggregates.

Dispersion is when dry soil is wet with pure water (e.g. rain water) and the clay structures that bind the fine aggregates and large particles (sand and silt) break down. The clay particles then go into suspension in the water. As the soil dries out the clay particles block the pores between the remaining aggregates. This blockage prevents the flow of water and air through the soil. Dispersion is enhanced when the soil has a high exchangeable sodium concentration, and from excessive tillage when the soil is wet.

Soil structure can be modified and improved by inputs of organic matter such as mulches, composts or cover crops. These help stabilise aggregate macro-structure. The application of gypsum to soil stabilises aggregate micro-structure and prevents clay dispersion. Excessive tillage can break down both the macro- and micro-structure of aggregates leading to hardsetting and crusting of surface soils.

Equipment

There is a simple method to measure soil slaking and dispersion. You will need:

- Shallow, clear, open containers;
- Rain water or distilled water;
- A handful of soil from each soil layer being assessed;
- Recording sheet and pen.

Timing

This assessment is best undertaken when soil sampling is conducted.

Method

1. Take three surface soil and three subsoil samples from each site as described in points 1-5 in *Taking soil samples*. Ensure that surface soil and subsoil are not combined so that they can be analysed separately.
2. From each sample, select three aggregates about the size of a pea.
3. Place them carefully, equally spaced, in a shallow container filled with rain or distilled water (you can also do this test using your irrigation water if you are interested in its effect on structural stability of the soils in the vineyard).

4. Watch the aggregates closely during the first few minutes and note whether they float on the surface or sink, and the rate at which smaller particles break away from the larger sample (slaking).
5. After 2 hours record whether slaking was complete, partial or absent.
6. Leave the dish untouched for 20 hours and then assess dispersion. A 'cloudy' or 'milky' halo around the slaked fragments of the aggregate indicates partial dispersion. Complete dispersion is indicated when the base of the container is completely covered with a layer of clay leaving only a pile of sand where the aggregate was placed.
7. If no dispersion occurred, take another sample from the air dried soil, remove any gravel, stones and plant fragments and moisten with rain or distilled water while kneading into a ball of about 40mm diameter. Add small amounts of water as necessary until the ball of soil just begins to stick to the hand.
8. Break the ball of soil open and remove some soil to make 3 pea size balls and place them in a clear container as described above.
9. Observe and record the results.

Interpreting results

The soil is a slaking soil if the aggregates have broken down into micro-aggregates at the end of the test period.

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Further information

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Dispersive soils come in 4 broad types depending on the amount of dispersion as indicated below.

Table 1. Disspersive soil types

Type 1	There has been complete dispersion such that a cloud of clay covers the bottom of the dish in a thin layer and the aggregate has almost disappeared. A small heap of sand may be left where the aggregate was placed. This type of soil is very likely to experience structural breakdown due to dispersion and will require treatment.
Type 2	There has been partial dispersion such that the dispersed clay has spread into thin streaks and crescents around the aggregate on the bottom of the container. This type of soil may experience some structural breakdown due to dispersion and could benefit from treatment.
Type 3	This soil only disperses after the clay has been worked. This means that very sound management practices can avoid crusting and erosion, but there is little room for error.
Type 4	Little dispersion occurred during the test, indicating that the aggregate structure of the soil is quite stable. The soil should not crust, and will have good rates of water entry, though it may still be susceptible to compaction.